(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 702 512 B1

(12) EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:
11.11.1998 Bulletin 1998/46

(51) Int Cl.[6]: **H05K 9/00**

(21) Application number: **95306257.7**

(22) Date of filing: **07.09.1995**

(54) Shielding device and method of mounting

Abschirmungsvorrichtung und Verfahren zur Montage

Dispositif de blindage et méthode de montage

(84) Designated Contracting States:
DE FR GB SE

(30) Priority: **07.09.1994 FI 944108**

(43) Date of publication of application:
20.03.1996 Bulletin 1996/12

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EP 0 702 512 B1

Printed by Jouve 75001 PARIS (FR)

Description

The invention relates to a shielding device particularly, but not exclusively, for the purposes of electromagnetic compatibility in a portable electronic apparatus, and a method for attaching said shielding device to a circuit board.

EMC (electromagnetic compatibility) has been defined as the capacity of electronic devices and systems to maintain such useful signal and interference signal level and frequency ratios as not to affect their performance too much when simultaneously used for their purpose under acceptable circumstances.

Tightening EMC requirements also imply higher requirements on electrical and telecommunication devices: the devices shall resist interferences of a specific type and level, and on the other hand, they must not cause excessive interference in their environment.

In view of electromagentic protection, portable mobile phones must be provided with integrated casings to reduce emission from a radiating object and to enhance radiation resistance of sensitive elements. In prior art mobile phone designs, EMC protection of the electronics of the device has usually been accomplished with separate metal sheets and casings, or metal-coated plastic casings. Such an EMC protective casing will usually enclose a number of components, so that the casing must be opened to make these components available for service and repair.

To provide access to components inside an EMC protective casing, it is known to fasten the casing edges with separate screws to the circuit board, thereby establishing galvanic contact between the board and the casing. However, such a known design has the inconvenience that mechanical tolerances may entail poor contact between the EMC protective casing, fastened with screws, and the circuit board. In addition, oxidation of the contacting conductive surfaces and unexpected high-frequency characteristics that may be inherent to some oxidation products formed on or near said surfaces may render the galvanic and/or thermal conductivity to the EMC protective casing inadequate. In this situation, the EMC protective casing or part of it will act as a high-frequency resonator element and start emitting or receiving radiation. This means that the protective effect of the EMC protective casing will be completely or partly lost. Impaired thermal conductivity between the circuit board and the EMC casing is also critical, because it may lead to large thermal gradients which stress the fastening.

In practical operation, several components being enclosed in the casing of the phone unit, the inconvenience described above will have a great impact. In EMC protective casings fastened with screws, oxidation affects reliablility and performances may be impaired by internal interferences. What is more, EMC protective casings are extremely difficult to open. Screw fastening is too awkward in production, small screws being difficult components to handle.

Another previously known way of attaching and detaching an EMC protective casing is to use a separate sheet metal cover soldered by robots. In current configurations, the use of soldered sheet metal as an EMC protection for electronics involves the drawback of rather inconvenient checking and repair of the solder joint. Metal-coated plastic casings require metal fastenings, which in turn must be fastened by soldering to the circuit board. Such a way of attaching and detaching an EMC protective casing is indeed far too slow.

A further drawback of this previously known design is that manufacturing a separate cover and attaching it to its frame entail material and labour costs. Moreover, a separate cover represents an additional component in the mobile phone, whose handling and maintenance causes extra costs. In fact, only very few EMC casings actually require opening for service and repair. For this reason, most of the separate covers will be superfluous components, which are never opened during the life cycle of the mobile phone. With separate covers, reliability is affected by oxidation and the increased number of components, and performances may be impaired by internal interferences. Separate covers are also difficult to open.

US 5,014,160 describes an EMI/RFI shield for shielding components on a printed circuit board. The shield has tabs which engage apertures in the printed circuit board. Tangs project from the tabs to frictionally engage the printed circuit board and to provide electrical contact thereto.

According to the present invention there is provided a protective casing (EC) for a circuit board comprising integral attachment pins for inserting into provided openings in the circuit board, at least one of said pins comprising a protrusion extending outwards from an otherwise regular surface of the pin, for producing a contact between the surface of said protrusion and an inner surface of a respective opening in the circuit board when said protective casing (EC) is attached to said circuit board, characterised in that said protrusion extends longitudinally along the pin.

Preferably a conductive shielding component is provided which comprises a number of specially designed pins, which pins are directed into respective conductively coated openings in the circuit board. The pins are formed in an integrated fabrication phase of the shielding component, so there will be no separate fastening means. Each pin is generally conical or convex in shape and comprises a protrusion that forms an outwards protruding bulge on one side of the pin. Said protrusion is urged against the inner surface of the respective opening in the circuit board when the shielding device is pressed into place, thereby establishing a contact that is both thermally and electrically conductive.

An advantage obtainable with the present invention is that an EMC protective casing may be provided which is simple and well suited for automated mass produc-

tion. Also, for inspection and repair purposes, it is readily opened and reclosed. Naturally, it fulfils the general requirement of adequately shielding the parts inside it against electromagnetic interference.

An embodiment of the invention will be described in detail below, by way of example only, with reference to the accompanying drawings, of which

Figure 1a shows the EMC protective casing according to the invention and a circuit board prior to attaching,

Figure 1b shows the EMC protective casing according to the invention attached to a circuit board,

Figure 1c is a detail of Figure 1b viewed from direction C, and

Figure 2 shows schematically several attacment pins viewed from below a circuit board.

Figures 1a and 1b illustrate attaching the EMC protective casing EC according to the invention to a circuit board. The circuit board 1 is provided with conductively coated openings 2 for fastening the EMC protective casing EC. Conductive coating is shown schematically in grey. Conical pins 3 cast in the EMC protective casing are fit into the openings 2 in the circuit board 1, the protrusions 4 of the pins 3 thus forming a press contact against the inner surface of the opening 2 of the circuit board 1. When necessary, the flexibility of the circuit board 1 can be increased by providing an auxiliary opening 5 on the protrusion side. Figure 1c is a detail of the arrangement illustrated in Figure 1b, in which the approximately circular cross-section of a pin 3 can be seen from direction C, that is, from below the circuit board 1. The protrusion 4 bulges outwards from the general shape of the pin 3 and is pressed against the wall of the conductively coated opening 2. Slight flexible deformation is caused in the board and coating materials resulting in a firm press contact between the conductive coating (shown in grey) and the protrusion 4.

The bevelled surface of the pin 3 being wedged into the metal-coated wall of the opening 2, the matching surfaces will be cleaned under the effect of the sliding movement. In this manner, contact will be ensured despite of impurities and oxides, and a hermetic joint will be provided, reducing subsequent oxidation.

The impact of dimension differences on the positioning of the pins 3 into the openings 2 is eliminated by making the contact portion of the pins 3 penetrate the circuit board material to a depth equalling any dimension variation. The metal-coated openings 2 have been confirmed to have adequate malleability.

Figure 2 shows an advantageous arrangement of the above explained attachment means with respect to each other The openings are generally made so that the board doesn't have any critical foil, conductive strip or component near the side against which the protrusion of the pin is pressed. This is to ensure that the slight flexible deformation of the board material does not cause any damage. The protrusion of the pin is made so as to face the edge 6 of the board, if the opening is near the edge 6 like the two top openings in Figure 2. With the opening not close to the edge, the protrusion is directed parallel to the wall 7 of the protective casing, which is shown as a dashed line in Figure 2. When necessary, the flexibility of the circuit board is again enhanced by means of an auxiliary opening at the protrusion side of each opening.

The pressing tightness of the pins of the EMC protective casing and the shape of the protrusion can be dimensioned so as to provide a reliable joint. The base of the pins may be rounded in order to provide mechanical strength. In this case, the surface of the EMC protective casing must be suitably designed so that the rounded base of the pins does not leave the casing suspended within a distance from the surface of the circuit board.

An advantageous method of fabricating the EMC protective casing according to the invention is casting. It has been found that the inclusion of attachment pins according to the invention in the design doesn't cause any significant wear to the mould that is used in the casting process, because the material flows related thereto are small. The pin will retain its shape as long as the mould lasts.

Metal, like aluminium (Al) or magnesium (Mg), may be used as a material in the EMC protective casing according to the invention. The guidability of the protective casing in the assembly phase may be enhanced by providing guide pins.

The fastening method according the invention provides a reliable electric and mechanical joint. Moreover, the EMC protective casing is readily attached and detached, even repeatedly when necessary.

In conclusion, the EMC protective casing according to the invention is economic, easy to manufacture and requires relatively little space on the circuit board. The protective casing according to the invention does not require separate elements for fastening or contact, and it has sufficient thermal conductivity from the circuit board to the protective casing.

In view of the foregoing description it will be evident to a person skilled in the art that various modifications may be made within the scope of the invention. For example, the casing and assembly may not necessarily be for EMC, but may be directed to inhibiting the ingress of contaminants into the enclosure formed by the casing, therefore obviating the need for conductive openings or a conductive casing.

Claims

1. A protective casing (EC) for a circuit board comprising integral attachment pins (3) for inserting into provided openings (2) in the circuit board (1), at

least one of said pins comprising a protrusion (4) extending outwards from an otherwise regular surface of the pin (3), for producing a contact between the surface of said protrusion (4) and an inner surface of a respective opening (2) in the circuit board (1) when said protective casing (EC) is attached to said circuit board (1), characterised in that said protrusion extends longitudinally along the pin.

2. A protective casing (EC) as claimed in claim 1, characterised in that said pins (3) are convex in shape, and the surface of said protrusion (4) is bevelled with respect to the longitudinal axis of said at least one pin (3), in order for said protrusion (4) to be wedged against the inner surface of the respective opening (2) in the circuit board (1), thereby producing a cleaning movement of the contacting surfaces when said protective casing (EC) is attached to said circuit board (1) by inserting said at least one pin (3) into respective opening (2).

3. A protective casing (EC) as claimed in claim 1 or 2, characterised in that the pins (3) are dimensioned such that the effect of dimension variations on the positioning of the pins (3) into the openings (2) has been inhibited by making the contact portion of the pins (3) penetrate the circuit board material to a depth equalling any dimension variation.

4. A protective casing (EC) as claimed in any of the preceding claims, characterised in that a said at least one pin (3) for insertion into an opening proximal to an edge (6) of said circuit board (1) is made such that the protrusion (4) of the pin (3) is directed towards said edge of the board (1).

5. A protective casing (EC) as claimed in any of the preceding claims, characterised in that a said at least one pin (3) for insertion into an opening distal an edge (6) of said circuit board (1) is made such that the protrusion (4) of the pin (3) is directed parallel to the wall of the EMC protective casing.

6. A protective casing (EC) as claimed in any of the preceding claims, characterised in that it comprises guide pins to be inserted into respective guiding holes in said circuit board, in order to enhance the positioning of the EMC protective casing on the circuit board (1)

7. A protective casing (EC) as claimed in any of the preceding claims, characterised in that it comprises conductive material.

8. A protective casing (EC) as claimed in claim 7, characterised in that it is made of aluminium (Al).

9. A protective casing (EC) as claimed in claim 7, characterised in that it is made of magnesium (Mg).

10. A protective casing (EC) as claimed in any of the preceding claims, characterised in that it is made by casting.

11. An assembly comprising a casing EC according to any preceding claim and a circuit board (1), wherein said circuit board (1) is provided with openings (2) for coupling said casing (EC) to said circuit board (1) and said casing (EC) is disposed on said circuit board (1) such that attachment pins (3) are inserted in respective openings (2).

12. An assembly according to claim 11, wherein the openings are conductive openings.

13. A method of assembling the assembly of claim 11 or 12 and comprising:

- inserting said at least one attachment pin (3) into a respective opening (2) in said circuit board (1); and
- pressing against said circuit board (1), thereby bringing the surface of said protrusion (4) into contact with the inner surface of the respective opening (2).

14. A method as claimed in claim 13, wherein the pressing force that is used to press said protective casing against said circuit board is such as to produce a relative sliding movement between the surface of said protrusion (4) and the inner surface of the respective opening (2) and to cause a local deformation of the material of said circuit board (1).

15. A method as claimed in claim 13 or 14, wherein the flexibility of the circuit board (1) is enhanced by providing an auxiliary opening (5) near the point that will come into contact with said protrusion (4).

16. A method as claimed in any of claims 13 to 15, wherein the openings (2) are made so that on the circuit board, there is no critical foil or component near the side of the opening (2) against which the protrusion (4) of at least one pin (3) is pressed.

Patentansprüche

1. Schutzgehäuse (EC) für eine Leiterplatte, mit integrierten Befestigungsstiften (3) zum Einführen in ausgebildete Öffnungen (2) in der Leiterplatte (1), wobei mindestens einer der Stifte einen Vorsprung (4) enthält, der sich von einer ansonsten regelmäßigen Oberfläche des Stifts (3) nach außen erstreckt, um zwischen der Oberfläche des Vorsprungs (4) und einer inneren Oberfläche einer je-

weiligen Öffnung (2) in der Leiterplatte (1) einen Kontakt herzustellen, wenn das Schutzgehäuse (EC) auf der Leiterplatte (1) befestigt ist, **dadurch gekennzeichnet,** daß sich der Vorsprung der Länge nach entlang des Stifts erstreckt.

2. Schutzgehäuse (EC) nach Anspruch 1, **dadurch gekennzeichnet,** daß die Stifte (3) eine konvexe Form aufweisen, und die Oberfläche des Vorsprungs (4) in Bezug zur Längsachse des mindestens einen Stifts (3) abgeschrägt ist, um den Vorsprung (4) gegen die innere Oberfläche der jeweiligen Öffnung (2) in der Leiterplatte (1) zu verkeilen, wodurch durch Einführen des wenigstens einen Stifts (3) in die jeweilige Öffnung (2) eine Reinigungsbewegung der Kontaktoberflächen erzeugt wird, wenn das Schutzgehäuse (EC) auf der Leiterplatte (1) befestigt wird.

3. Schutzgehäuse (EC) nach Anspruch 1 oder 2, **dadurch gekennzeichnet,** daß die Stifte (3) derart dimensioniert sind, daß die Auswirkung von Dimensionsänderungen auf das Positionieren der Stifte (3) in den Öffnungen (2) gehemmt wird, indem der Kontaktbereich der Stifte (3) mit einer jegliche Dimensionsänderung ausgleichenden Tiefe das Leiterplattenmaterial durchdringt.

4. Schutzgehäuse (EC) nach irgendeinem der vorangegangenen Ansprüche, **dadurch gekennzeichnet,** daß der mindestens eine Stift (3) zum Einführen in eine Öffnung in der Nähe einer Kante (6) der Leiterplatte (1) derart ausgebildet ist, daß der Vorsprung (4) des Stifts (3) in Richtung der Kante der Leiterplatte (1) weist.

5. Schutzgehäuse (EC) nach irgendeinem der vorangegangenen Ansprüche, **dadurch gekennzeichnet,** daß der mindestens eine Stift (3) zum Einführen in eine Öffnung entfernt von einer Kante (6) der Leiterplatte (1) derart ausgebildet ist, daß der Vorsprung (4) des Stifts (3) parallel zur Wand des EMV-Schutzgehäuses ausgerichtet ist.

6. Schutzgehäuse (EC) nach irgendeinem der vorangegangenen Ansprüche, **dadurch gekennzeichnet,** daß es Führungsstifte zum Einführen in jeweilige Führungslöcher in der Leiterplatte enthält, um das Positionieren des EMV-Schutzgehäuses auf der Leiterplatte (1) zu verbessern.

7. Schutzgehäuse (EC) nach irgendeinem der vorangegangenen Ansprüche, **dadurch gekennzeichnet,** daß es leitfähiges Material enthält.

8. Schutzgehäuse (EC) nach Anspruch 7, **dadurch gekennzeichnet,** daß es aus Aluminium (AL) gebildet ist.

9. Schutzgehäuse (EC) nach Anspruch 7, **dadurch gekennzeichnet,** daß es aus Magnesium (Mg) gebildet ist.

10. Schutzgehäuse (EC) nach irgendeinem der vorangegangenen Ansprüche, **dadurch gekennzeichnet,** daß es durch Gießen gebildet ist.

11. Aufbau mit einem Gehäuse (EC) nach irgendeinem der vorangegangenen Ansprüche und einer Leiterplatte (1), wobei zur Kopplung des Gehäuses (EC) mit der Leiterplatte (1) die Leiterplatte (1) mit Öffnungen (2) versehen ist, und das Gehäuse (EC) derart auf der Leiterplatte (1) angeordnet ist, daß die Befestigungsstifte (3) in jeweiligen Öffnungen (2) eingeführt sind.

12. Aufbau nach Anspruch 11, wobei die Öffnungen als leitfähige Öffnungen ausgebildet sind.

13. Verfahren zum Zusammenbauen des Aufbaus nach Anspruch 11 oder 12, mit folgenden Schritten:

- Einführen des mindestens einen Befestigungsstifts (3) in eine jeweilige Öffnung (2) in der Leiterplatte (1); und
- Drücken gegen die Leiterplatte (1), wodurch die Oberfläche des Vorsprungs (4) mit der inneren Oberfläche der jeweiligen Öffnung (2) in Kontakt gebracht wird.

14. Verfahren nach Anspruch 13, bei dem die aufgewendete Druckkraft, um das Schutzgehäuses gegen die Leiterplatte zu drücken, derart ist, daß zwischen der Oberfläche des Vorsprungs (4) und der inneren Oberfläche der jeweiligen Öffnung (2) eine relative Gleitbewegung und eine lokale Verformung des Materials der Leiterplatte (1) erzeugt wird.

15. Verfahren nach Anspruch 13 oder 14, bei dem die Flexibilität der Leiterplatte (1) verbessert wird, indem eine Hilfsöffnung (5) in der Nähe des Punktes gebildet ist, der mit dem Vorsprung (4) in Kontakt tritt.

16. Verfahren nach irgendeinem der Ansprüche 13 bis 15, bei dem die Öffnungen (2) derart ausgebildet sind, daß auf der Leiterplatte in der Nähe der Seite der Öffnung (2), gegen die der Vorsprung (4) mindestens eines Stifts (3) drückt, keine kritische Folie oder Komponente ausgebildet ist.

Revendications

1. Boîtier de protection (EC) pour une plaquette à circuits comprenant des broches d'attachement solidaires (3) pour insertion dans des ouvertures (2)

pratiquées dans la plaquette à circuits (1). au moins l'une desdites broches comportant une saillie (4) s'étendant vers l'extérieur d'une surface par ailleurs régulière de la broche (3), afin de produire un contact entre la surface de ladite saillie (4) et une surface intérieure d'une ouverture respective (2) dans la plaquette à circuits (1) lorsque ledit boîtier de protection (EC) est attaché à ladite plaquette à circuits (1), caractérisé en ce que ladite saillie s'étend longitudinalement le long de la broche.

2. Boîtier de protection (EC) selon la revendication 1, caractérisé en ce que lesdites broches (3) ont une forme convexe et la surface de ladite saillie (4) est chanfreinée par rapport à l'axe longitudinal de ladite au moins une broche (3), afin que ladite saillie (4) soit calée contre la surface intérieure de l'ouverture respective (2) dans la plaquette à circuits (1), d'où l'obtention d'un mouvement de nettoyage des surfaces en contact lorsque ledit boîtier de protection (EC) est fixé à ladite plaquette à circuits (1) par insertion de ladite au moins une broche (3) dans une ouverture respective (2).

3. Boîtier de protection (EC) selon la revendication 1 ou 2. caractérisé en ce que les broches (3) sont dimensionnées de façon que l'effet des variations des dimensions sur le positionnement des broches (3) dans les ouvertures (2) soit inhibé en faisant en sorte que la portion de contact des broches (3) pénètre le matériau de la plaquette à circuits suivant une profondeur égale à toute variation des dimensions.

4. Boîtier de protection (EC) selon l'une quelconque des revendications précédentes, caractérisé en ce qu'une dite au moins une broche (3) pour insertion dans une ouverture proche d'un bord (6) de ladite plaquette à circuits (1) est réalisée de façon que la saillie (4) de la broche (3) soit dirigée vers ledit bord de la plaquette (1).

5. Boîtier de protection (EC) selon l'une quelconque des revendications précédentes, caractérisé en ce qu'une dite au moins une broche (3) pour insertion dans une ouverture distante d'un bord (6) de ladite plaquette à circuits (1) est réalisée de façon que la saillie (4) de la broche (3) soit dirigée parallèlement à la paroi du boîtier de protection EMC.

6. Boîtier de protection (EC) selon l'une quelconque des revendications précédentes. caractérisé en ce qu'il comprend des broches de guidage devant être insérées dans des trous de guidage respectifs de ladite plaquette à circuits. dans le but d'améliorer le positionnement du boîtier de protection EMC sur la plaquette à circuits (1).

7. Boîtier de protection (EC) selon l'une quelconque des revendications précédentes. caractérisé en ce qu'il comprend un matériau conducteur.

8. Boîtier de protection (EC) selon la revendication 7, caractérisé en ce qu'il est constitué d'aluminium (A1).

9. Boîtier de protection (EC) selon la revendication 7, caractérisé en ce qu'il est constitué de magnésium (Mg).

10. Boîtier de protection (EC) selon l'une quelconque des revendications précédentes. caractérisé en ce qu'il est fabriqué par coulage.

11. Ensemble comprenant un boîtier EC selon l'une quelconque des revendications précédentes, et une plaquette à circuits (1), dans lequel ladite plaquette à circuits (1) présente des ouvertures (2) pour l'accouplement dudit boîtier (EC) à ladite plaquette à circuits (1), et ledit boîtier (EC) est disposé sur ladite plaquette à circuits (1) de façon que des broches d'attachement (3) soient insérées dans des ouvertures respectives (2).

12. Ensemble selon la revendication 11, dans lequel les ouvertures sont des ouvertures conductrices.

13. Méthode d'assemblage de l'ensemble selon la revendication 11 ou 12, comportant :

- l'insertion d'au moins une broche d'attachement (3) dans une ouverture respective (2) dans ladite plaquette de circuits (1); et
- la pression contre ladite plaquette de circuits (1), portant ainsi la surface de ladite saillie (4) en contact avec la surface interne de l'ouverture respective (2).

14. Méthode selon la revendication 13, dans laquelle la force de pression qui est utilisée pour presser ledit boîtier de protection contre ladite plaquette de circuits est telle qu'un mouvement de glissement relatif est produit entre la surface de ladite saillie (4) et la surface interne de l'ouverture respective (2) et qu'une déformation locale du matériau de ladite plaquette de circuits est provoquée.

15. Méthode selon la revendication 13 ou 14. dans laquelle la flexibilité de la plaquette de circuits (1) est accrue en prévoyant une ouverture auxiliaire (5) à proximité du point qui vient en contact avec ladite saillie (4).

16. Méthode selon l'une quelconque des revendications 13 à 15, dans laquelle les ouvertures (2) sont faites de façon à ce qu'il n'y est pas. sur la plaquette de circuits, de feuille ou de composant critique pro-

che du côté de l'ouverture (2) contre laquelle la saillie (4) d'au moins une broche (3) est pressée.

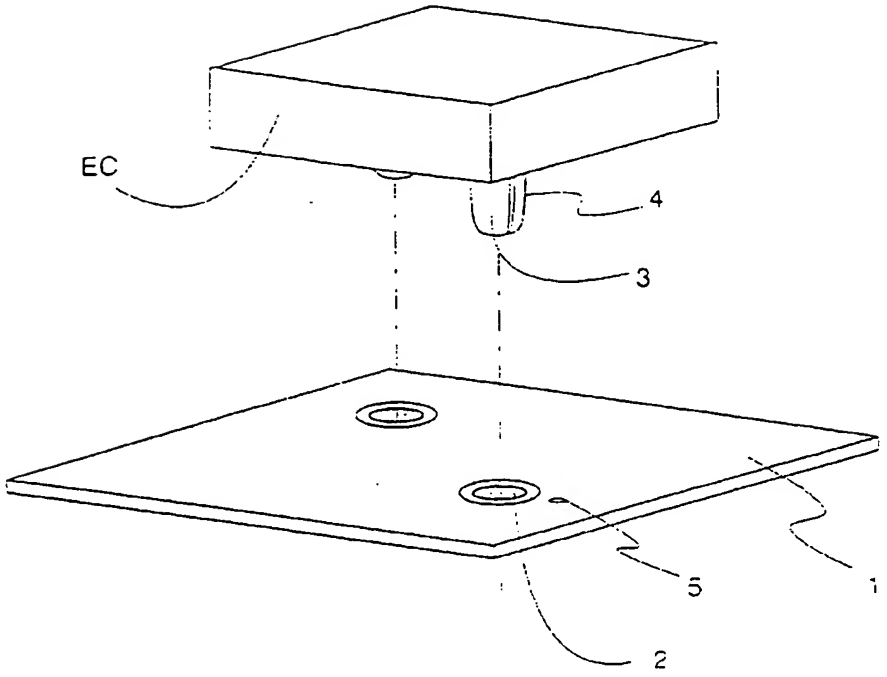

Fig. 1a

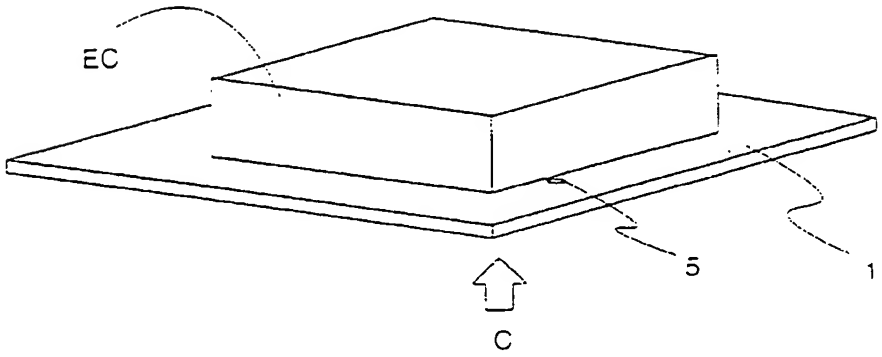

Fig. 1b

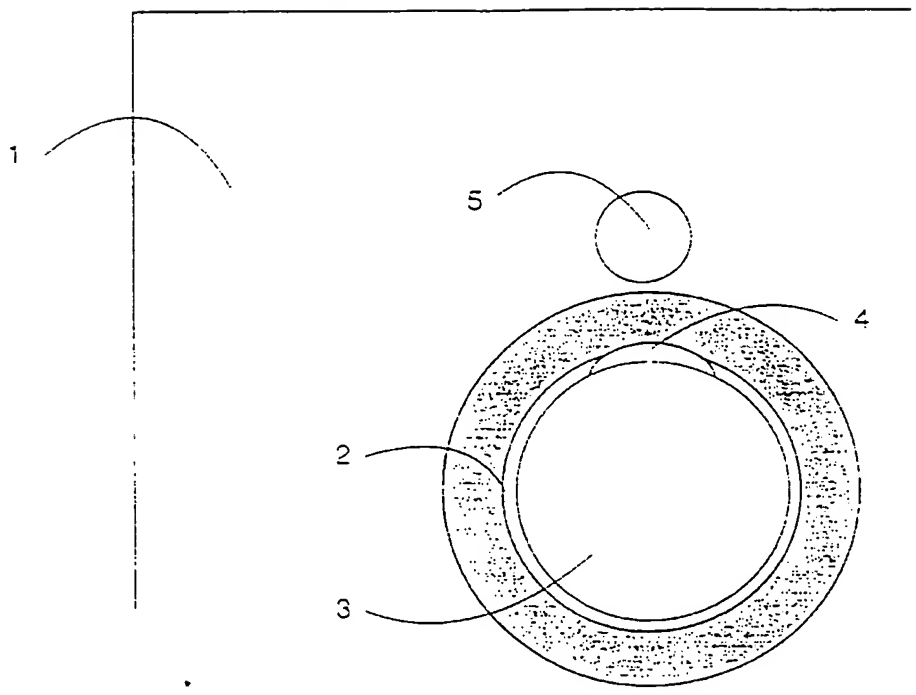

Fig. 1c

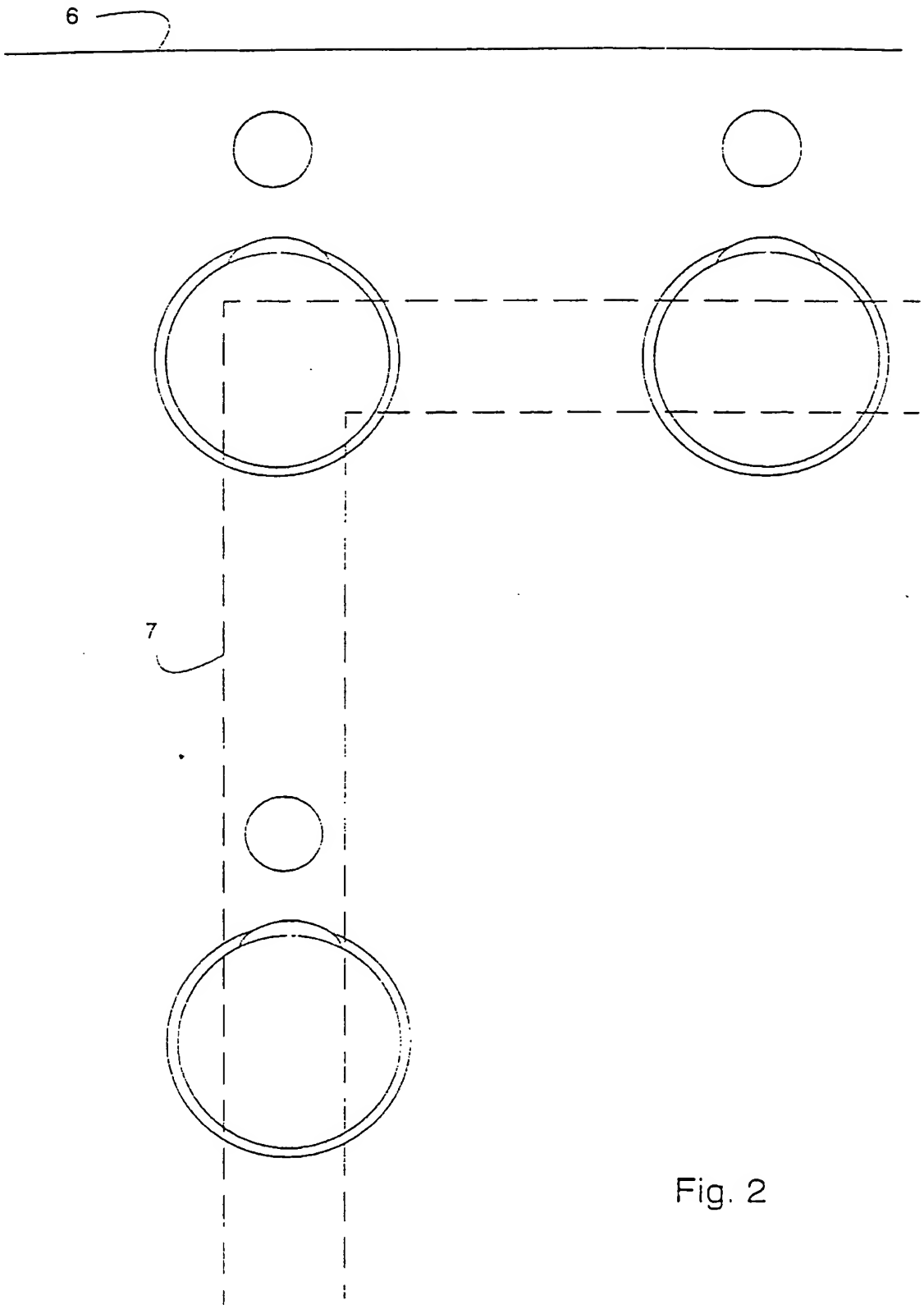

Fig. 2